

There is only one point left for explanation, and this is the band-like appearance of the light at distances from the sun of more than 90° .

Many years ago I made a careful reduction of the star gages of the two Herschels in order to eliminate the Milky Way as far as possible, for Proctor had shown that there is good reason for supposing that the Milky Way is an irregular stream of stars at no great distance, comparatively speaking, from our solar system. The results are given in Table 8. The north galactic pole was taken to be at right ascension $12^h 47^m$, north polar distance 59° in 1860, and the numbers of stars given are those seen in the field of view of a telescope 15 inches in diameter. I may say that the observations were very irregularly distributed over the heavens; in some of the areas marked off by galactic longitudes and latitudes there were a large number of observations, in others there were none at all.

TABLE 8.—*Herschel's star gages.*

Galactic north polar distance.	Number of stars in field of view.
0 to 15	No observation made.
15 to 30	5.2
30 to 45	7.0
45 to 60	12.2
60 to 75	21.8
75 to 90	{ 41.1 not on Milky Way. 133.9 on Milky Way.
90 to 105	{ 126.1 on Milky Way. 49.2 not on Milky Way.
105 to 120	27.2
120 to 135	18.4
135 to 150	9.1
150 to 165	6.5
165 to 180	5.7

It will here be seen that the rise in the number of the stars, from about 45 on or near the Galactic equator to 130 on the Milky Way itself, produces that band-like appearance so familiar to us all, and so it is with the zodiacal light—there is somewhat rapid condensation near the invariable plane which produces the same appearance as in the case of the Milky Way.

THE ZODIACAL LIGHT—IS IT METEOROLOGICAL OR ASTRONOMICAL?

In printing the preceding memoir by Mr. Maxwell Hall, on the zodiacal light, we hope to contribute something to the question whether this appearance in the sky is due principally to astronomical or meteorological conditions. For two centuries it was considered to be a purely astronomical phenomenon, and supposed to be a flat disk ring of meteoric matter inside the orbit of Venus; but, as observations increased, the extent of the orbit had to be increased, until finally the very accurate work by Rev. George Jones, carried out during the Wilkes Exploring Expedition around the globe, and published

in full in one large volume, established beyond a doubt the fact that the orbits of the meteors must extend beyond the earth's orbit. As this seemed incompatible with the stability of the earth's orbit, efforts were made to reconcile the observations with the hypothesis that we were observing a meteoric ring revolving about the earth, analogous to the inner crêpe or dusky ring of Saturn. But the laws of mechanics forbade the permanent existence of such a ring. Attention was then called to the fact that we have no record of the zodiacal light ever having been observed from the high mountain tops; whence it follows that, in some way or other, this light must have its origin in some condition peculiar to the lower atmosphere. Therefore for many years the zodiacal light has been noted by meteorological observers, especially by those who have some interest in astronomy. The conclusions arrived at by Dr. Maxwell Hall, however, would relegate the phenomenon to the department of astrophysics instead of terrestrial physics, so that the only influence of the atmosphere would be to render obscure the fainter details. If this be so then the light should be visible from the summits of mountains even better and more frequently than from the low lying stations; and we especially commend it to the attention of observers at high stations throughout the world, whether on plateaus or on mountains.—C. A.

CORRIGENDA.

MONTHLY WEATHER REVIEW for October, 1905, Vol. XXXIII, No. 10, page 445, first column, line 1; for "August 24" read "August 4". Also in the same column, the first line beneath the dash, for "—4" read "—2".

MONTHLY WEATHER REVIEW for January, 1906, Vol. XXXIV, No. 1, page 14, second column, table at foot: in every case for "P" read "C"; also page 15, second column, Table 8, at head of each subcolumn make the same change.

MONTHLY WEATHER REVIEW for January, 1906, Vol. XXXIV, No. 1, page 15, first column, line 17, for "cirro-cumulus" read "strato-cumulus." Page 30, second column, line 2, beneath title "Tornadoes," etc., for "Wake County, N. C.," read "Rowan County, N. C."

MONTHLY WEATHER REVIEW for March, 1906, page 111, second column, line 2, for

$$\int_{-\infty}^{\infty} T = T_m, \text{ and } \frac{T_m}{T_0} = (1 + 0.367 \theta) = (1 + a\theta),$$

read

$$\frac{1}{z - z_0} \sum_{z_0}^z T_z = T_m, \text{ and } \frac{T_m}{T_0} = (1 + 0.367 \theta) = (1 + a\theta).$$

Page 114, first column, formulas (42) and (43), and the text below, change the expressions for angular velocity from $(2n + \nu)$ to $(2\omega + \nu)$.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

North Atlantic weather was notably severe. During the first half of the month low barometric pressure prevailed over the British coasts and the barometer continued high over the Azores. During the last half of the month an area of high barometer persistently covered the British Isles, and low barometric pressure and stormy weather prevailed from the region of the Azores eastward over southwestern Europe.

In the United States the course and character of areas of high and low barometric pressure produced strikingly abnormal weather. Temperature was generally deficient, and in an area extending from the lower Ohio Valley over the middle-eastern slope of the Rocky Mountains the deficiency was 9° to 10° F. Except on the north Pacific coast and in limited areas east of the Rocky Mountains precipitation was in excess

of the March average, and in interior portions of the middle and east Gulf States, Georgia, and northern California the excess exceeded four inches. Southern and eastern districts were visited by a number of storms of unusual severity, and the second decade of the month covered a period of exceptionally low temperature and heavy snow in an area extending from Lake Superior over the Missouri Valley and the middle and northern Rocky Mountain and Plateau districts.

From the 1st to 4th an area of low barometer advanced from Colorado to the Canadian Maritime Provinces, attended by heavy snow in the Middle-western and Northwestern States on the 1st and in the Missouri Valley and the northern Lake region on the 2d, and by heavy rain from the southern Lake region and the Ohio Valley to the east Gulf and south Atlantic

coasts on the 3d. Among other prominent features noted in connection with this storm were barometric pressure below 29.00 inches in Colorado on the 1st, a well-defined tornado at Meridian, Miss., the evening of the 2d, and high winds on the New England coast. From the 3d to the 10th a storm advanced from the middle Plateau to the Gulf of Mexico, and passed thence northeastward to the Canadian Maritime Provinces, with barometric pressure falling to a reported minimum of 28.52 inches at Chatham, N. B., on the morning of the 10th. Heavy rain fell in the east Gulf and South Atlantic States the night of the 7-8th, and a severe northeast shifting to northwest gale began on the New England coast the night of the 8th, and continued through the 9th and 10th. From the 9th to 12th a storm advanced from the north Pacific coast southeastward over the Rocky Mountain districts and central valleys, and thence northeastward to the Gulf of St. Lawrence, attended on the 10th and 11th by heavy snow from the northern Plateau over the middle and northern Rocky Mountain districts, the Missouri, upper Mississippi, and Ohio valleys, and the lower Lakes.

During the second decade of the month barometric pressure continued low over the middle Plateau, and the passage from that region across the Southern and Eastern States of areas of low barometer was attended by the most widespread storms of the season. Heavy rain fell during this period in southern and heavy snow in northern districts from the Atlantic to the Pacific, extremely cold weather prevailed from the middle and northern Plateau regions over the Missouri Valley and the upper Lake region, and northeast to northwest gales occurred on the middle Atlantic and New England coasts.

From the 23d to 27th a storm moved from the north Pacific coast to the Gulf of St. Lawrence, attended by general rains throughout its course, and on the 26th by heavy rains and thunderstorms in the lower Missouri and middle and upper Mississippi valleys. The last important storm of the month appeared over Colorado on the 26th, moved thence southeastward to the Gulf of Mexico, and then northeastward, and passed off the middle Atlantic coast during the 31st. This storm was attended by heavy rain in the Gulf, Middle Atlantic, and New England States, and the Ohio Valley. At the close of the month a barometric depression from the north Pacific coast occupied the region north of Montana.

The heavy rains of the second and third decades of March caused high water in the streams of California, and on the 31st the Mississippi and Ohio rivers and tributaries were rising rapidly.

From the 1st to the 5th and during a greater portion of the second decade of the month very low temperature prevailed generally over the United States, the severest cold in interior, northern, and northwestern sections being experienced from the 10th to 15th. This period of cold weather culminated on the 14th, when temperature 20° to 30° below zero was registered in the upper Missouri Valley, and zero temperature from Wyoming over Minnesota and upper Michigan. At the close of the second decade the interior of Texas, the middle and east Gulf coasts, and extreme northern Florida were visited by heavy frost. From the 21st to 23d a moderate cold wave advanced from the British Northwest Territory eastward over the northern districts. After the 23d no well-defined cold wave appeared.

BOSTON FORECAST DISTRICT.

In New England there was a prevalence of low temperature, with heavy snowfall and several severe storms. The snowfall was unusually heavy in all sections, and in amount exceeded the total fall of the preceding winter months. The severe storms of the month were those of the 9-10th, 15-16th, and 19-20th, all of which caused more or less damage to shipping with considerable loss of life along the coast, the last one being one of the most destructive for many years, and by many

considered the worst storm since the so-called "blizzard" of March 11-13, 1888. According to published reports six lives were lost and fourteen vessels were wrecked or damaged on the New England coast during this great storm. The heavy snow of the month was very favorable for lumbering interests, and the low temperature for the harvesting of ice. Ample warnings were issued for all storms and cold waves, and none occurred without warnings.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.

Over the interior of the west Gulf States the month was stormy and disagreeable. On the coast storm warnings were neither ordered nor required. Cold-wave warnings were issued for a considerable area on the 10th and 11th, and were generally justified. A cold wave moved rapidly into Oklahoma and northwestern Texas on the morning of the 14th, without warnings having been issued. Cold-wave warnings were ordered on that date for Arkansas, northeastern Texas, and northern Louisiana, and the temperature fell 30°, or more, generally over the region indicated. Frost and freezing temperature, for which warnings were issued, extended almost to the coast line on the 20th and 21st.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.

The month was wet and exceptionally cold, and heavy rains during the latter portion caused rapid rises in the Ohio River and tributaries, with flood stages at many points. Cold-wave warnings were ordered for Kentucky and Tennessee on the mornings of the 11th and 14th, and for central and eastern Tennessee on the morning of the 12th.—*F. J. Wals, District Forecaster.*

CHICAGO FORECAST DISTRICT.

Compared with the preceding winter months March was relatively cold. A few cold-wave warnings were ordered, but no general cold-wave warning for the entire district was issued. On the morning of the 2d heavy snow warnings were issued for Minnesota, Nebraska, eastern South Dakota, and northwestern Iowa, and considerable snow with strong winds followed over the area covered by the advices. Winter navigation continued to a limited degree on Lake Michigan, and the companies operating steamers were advised from time to time before impending storms. Steamers coming into Chicago Harbor were delayed considerably on March 26 by ice that had been driven to the southern end of the lake by northerly winds.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

Except in extreme southern portions of Arizona and New Mexico the month was much colder than usual, and in Wyoming and eastern Colorado it was the coldest March on record. Precipitation was in excess, except in extreme southern New Mexico; and in western Wyoming, western Colorado, southern Utah, and northern Arizona the amounts reported were the greatest on record. The greatest part of the precipitation was in the form of wet snow, resulting in numerous snow slides in the San Juan district in southwestern Colorado, which blockaded for weeks the railroad in the Canyon of the Animas, between Durango and Silverton, besides sweeping away many mining buildings and causing the death of the occupants. The melting of the heavy snow in Wyoming, during the warm spell that followed the cessation of the prolonged storm, taxed the streams, many of which overflowed their banks, with the loss of a number of bridges. Ten lives were lost and a number of persons were injured as the result of the washing away of a railroad bridge in eastern Wyoming. The greatest amount of precipitation fell from the 10th to the 18th, inclusive, during which period an area of low barometer persisted west of the mountains.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.

A disturbance that appeared on the north Pacific coast on the 2d developed considerable intensity. From the 5th to

10th pleasant weather prevailed. During a great portion of the second decade of the month a barometric depression occupied the middle Plateau region, causing high southwest winds and heavy rain, and snow in the mountains. Warnings of high winds and a decided fall in temperature were issued on the 12th. A succession of storms marked the last decade of the month.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND FORECAST DISTRICT.

The special feature of the month in the North Pacific States and Idaho was a cold spell during the second decade. During the first two or three days of this period high northeast winds and snow prevailed. Warnings were ordered for three storms and were justified in each instance. Cold-wave warnings were ordered in southeastern Idaho on the 12th and were justified.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

During the month three periods of heavy rains were followed by floods in the watersheds affected. The first district visited was the southeast on the 18th and 19th, and by the 20th and 21st flood stages were general, except in the Carolinas and northeastern Georgia, where the rivers were not above the danger lines as a rule. The usual warnings were issued in all cases.

The flood in the Ocmulgee River, while not at all unusual as far as the actual stages of water were concerned, was nevertheless a very trying one from the fact that it was the fourth in about four months, and the second within a week. The warnings, of course, enabled citizens to remove or protect portable property, but damage to fixed improvements could not be prevented.

The frequent occurrence of these floods has determined the commercial and agricultural interests in the vicinity of Macon, Ga., to protect themselves from further loss, and preliminary arrangements are in progress for the construction of a substantial levee to extend southward from Macon for a distance of about five miles.

The Flint River rise was not pronounced, but in the Chattahoochee danger-line stages were common, although no great damage resulted.

In the watershed of the Alabama River the floods were quite severe with stages from 3 to 8 feet above the danger lines in the Coosa and Tallapoosa rivers, and 15 feet above in the Alabama. Preliminary warnings had been issued on the 15th on account of the heavy rains of the 14th over the northern portions of Georgia and Alabama, and, as heavy rains were again falling, additional warnings were sent out on the 19th, owners of property subject to overflow being advised to remove or protect the same. Railroad repair trains were immediately dispatched to points exposed to floods, live stock was driven from the bottoms, and goods and merchandise were removed from storehouses and basements that were afterwards flooded. The warnings were accurate in every detail and were especially commended by the press and all others interested. The conditions were very similar over the Black Warrior and lower Tombigbee rivers; stages from 15 to 20 feet above the danger lines were forecast, with excellent verification, and the warnings were instrumental in saving a large amount of property. Additional warnings became necessary on the 28th and 29th for continued high stages that persisted for several days after the end of the month. The flood waters covered the lowlands along the Black Warrior, and those along the Tombigbee for a distance of 25 miles above Demopolis, Ala. Near the confluence of the two rivers the water extended five miles beyond the river bed, all steamboat landings were submerged, and flat-

boats were used for transferring freight from the steamboats to the higher lands. To the lumber and milling interests, however, the floods were a distinct benefit, as these were enabled to move timber that had been cut for the market.

The floods in southeastern Mississippi were also of decided proportions. Stages at the river stations were as follows:

Station.	River.	Stage.	Danger line.
Hattiesburg, Miss.	Leaf.....	20.5	20
Enterprise, Miss.	Chickasawhay...	29.4	18
Shubuta, Miss.	Chickasawhay...	39.6	25
Merrill, Miss.	Pascagoula.....	21.7	20
Jackson, Miss.	Pearl.....	29.6	20
Columbia, Miss.	Pearl.....	23.0	14

Warnings were first issued on the 19th, and were supplemented by others whenever necessary. The stages forecast were reached within a fraction of a foot, and no reports of serious damage have been received.

The moderate floods of the last week of the month in the interior rivers of Ohio were due to the melting of the large quantity of accumulated snow that had fallen earlier in the month, assisted by a fair rainfall on the 25th and 26th. Some lowlands were overflowed, but no serious damage was reported.

The accuracy of the warnings that were issued for this flood has demonstrated that flood forecasts for the smaller rivers of Ohio can be made with gratifying exactness. The single disturbing factor was the uncertainty as to the weight that should be given to the melted snow; the usual estimates made from measurements of unmelted snow are often very misleading, and for precise work it is essential that the water equivalent of accumulated snowfall be determined at frequent intervals by exact measurements.

The rises in the Mississippi and Ohio rivers were caused by the heavy rains of the 25th and 26th, and of the 29th and 30th, and were still in progress at the end of the month. They will be described in the MONTHLY WEATHER REVIEW for April, 1906.

It has been ascertained from press reports that the melting snow floods in the rivers of Wyoming were much more severe than usual, resulting in considerable damage to railroads, etc., and great losses to stockmen. No river and flood service is maintained in Wyoming.

The California rains from the 20th to the 26th, inclusive, were followed by steadily rising waters over the Sacramento and San Joaquin watersheds. To the rain waters were added those coming from the melting of the deep snows on the mountains, causing destructive floods in many localities. The stages reached were not exceptionally high, but the resulting damage was widespread, without, however, any special instances of unusual character, except the complete interruption of railroad traffic for some time in southern California. The levees, with but one or two unimportant exceptions, remained intact. Warnings of the dangerous character of the floods were issued on the 23d, 24th, and 26th.

At the end of the month the rivers were practically free from ice except the Mississippi from Dubuque northward and the rivers of northern New England. The upper Missouri opened during the last few days of the month.

The highest and lowest water, mean stage, and monthly range at 307 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*